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Figure 1.



Roseate Tern (*Sterna dougalli*) Juvenile Plumage.
Photo by Lynds Jones.

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A CONTRIBUTION TO THE LIFE HISTORY OF THE
COMMON (*Sterna hirundo*) AND ROSEATE
(*S. dougalli*) TERNS.

BY LYNDS JONES.

THE COMMON TERN.

We are more indebted to Mr. George H. Mackay than to any one other person for what is known of the life history of this tern, as well as of the life history of the several species of the gulls and terns which breed on the coast of Massachusetts. Mr. Mackay's extended studies have appeared in volumes 12 to 16 inclusive of *The Auk*. I shall not repeat the points in the life history of this species which he has fully covered, but attempt to supplement what he has given, and to indicate changes in habits where they may have occurred in the interval between his studies and mine.

The studies upon which this paper are based were carried on during parts of the summers of 1903 and 4, with Woods Hole, Massachusetts, as a base of operations, and with all of the facilities of the Marine Biological Laboratory, and the United States Fish Commission at my command. To the directors of these two institutions my thanks are heartily tendered.

From July 8 to August 14, 1903, and from June 28 to August 12, 1904, the terns were under almost constant observation. Intensive studies were conducted at the Woepecket islands and on Muskeget island. The colonies on Penikese and

on No-mans-land islands were visited several times where comparative studies were made. Three visits to the colonies on the three Chicken islands and on North Harbor island in Lake Erie, enabled me to compare marine and inland colonies.

Muskeget island is typical of the low sandy islands to which the Woepeckets and a part of Tuckernuck belong. Such islands are covered with a growth of bunch grass and poison ivy, and with other vegetation of less consequence and relatively slight in quantity. The bunch grass forms dense masses in some places, but in others is in scattered bunches, and there are areas of some extent devoid of any vegetation. The broad beach is either sandy with few or no stones, or composed of boulders ranging from the size of pebbles to several tons in weight. Driftwood and sea weed are found everywhere. Penikese island is typical of the high islands which are covered with a strong turf with little or no other vegetation except on the islands of large area where forests maintain themselves with all the attendant vegetation. Of course the terns and gulls frequent only the borders of forest covered islands, and in the vicinity of Woods Hole are largely confined to Penikese, No-mans-land, and the outlying parts of Martha's Vineyard at the ocean end of Katama Bay.

Mr. Mackay states that but one brood is reared in a season. There is good evidence for believing that two broods are raised by a considerable proportion of the Common Terns. About June 10th nests with eggs are the most numerous, according to Captain Gibbs of the Life Saving Station on Muskeget island, and also Special Policeman Small of the same island. Also according to these gentlemen, there is a second maximum time for eggs, which occurs about July 10th. My observations corroborate this view. Upon my arrival on June 28, 1904, very few nests containing eggs were to be found, while two weeks later nests with eggs were found everywhere.

Mr. Mackay records very few nests containing 5 eggs, and inclines to believe that in exceptional cases one bird may have deposited all five eggs. I found three nests which contained 6 eggs, and a considerable number which contained 5. In every case where the nest contained more than 4 eggs it was

clear that two females had laid to the same nest. This was proved by the marked difference in the degree of incubation of two or three of the eggs from the rest in the nest, or by the marked difference in size and markings and texture of the shell. In a relatively small proportion of cases nests containing four eggs were clearly mixed sets. While many nests contained but one egg, I never met with a case where the single egg could be regarded as a nest complement. Either another or other eggs were laid in the nest later, or the nest proved to be deserted, or the egg was infertile and remained after the others had hatched. The usual number of eggs or young was



COMMON TERN. (*Sterna Hirundo.*)
Egg, Young Just Hatched, Young Two Days Old.
Woepacket Id., Mass.

three, but there were many nests with two eggs or young, and a somewhat smaller number with four eggs or young.

Contrary to many statements, I have never met with a case of no nest material in the case of this tern. A freshly made nest is usually a well constructed cup of dry grass, or dry drift seaweed, or other dry trash, arranged loosely in a depression in the sand, on drift seaweed, or among the beach pebbles or stones. The material is definitely arranged and pressed down to smoothness by treading and by pressing the breast against the nest material. Exposed nests are pretty certain to have most or all of the nest material blown away before the chicks leave the nest.

Nests are placed practically anywhere on the ground. The sandy beaches as well as the gravelly and stony exposed beaches are occupied, but there seems to be a marked tendency for the birds to prefer the upper reaches of the islands, placing the nests among the grasses and bushes and vines, but without attempts at concealment. On the Woepecket islands, however, where great boulders of several tons weight are scattered along certain parts of the beach, several nests were found beneath these boulders, or even placed well back in crevices or littles caves. The birds seem to demand a fairly broad outlook from the nest. The upland parts of Penikese island are covered with a strong turf which supports a luxuriant growth of grass. Among this grass the terns' nests are often raised from the ground by the thick matting of last year's growth.

Mr. Mackay states that wherever the nest may be placed the tern selects material which harmonizes with the surroundings. I have not found that to be true in enough cases to indicate any suggestion of intelligence on the part of the bird. Nests placed among the rubble of the beach are hard to see because the eggs resemble the pebbles, making the nest appear to be a wisp of drift. Nests placed on the light gray sand or grass are conspicuous objects, since both nest material and eggs form a strong contrast with the surroundings. It would seem, therefore, that the upland and sandy reaches nesting habit was a late acquisition, and that the birds have not yet fully adapted

themselves to the different environment which these places afford.

The eggs are generally deposited on successive days, rarely a whole day intervening between the deposition of two eggs. Incubation begins when the first egg is deposited, and the eggs hatch in the order in which they were deposited. The period of incubation for six nests studied was 21 days, or the same as for the domestic fowl.

Both male and female take regular turns sitting, but my observations indicate that the female spends more time on the nest than the male. In the cases studied, a bird later found to be the female, approached the nest abruptly and settled upon the eggs without any preliminaries. She remained quiet 40 minutes, when she uttered a peculiar call which was repeated at short intervals until a bird separated itself from the hovering cloud, or company at the water's edge, when she stood up, took a few steps, and flew away. The male alighted on the sand several rods to leeward of the nest and approached it gradually, simulated feeding, and called loudly at intervals. When he reached the nest he merely stood over the eggs to protect them from the scorching rays of the sun, and kept calling at intervals. In 20 minutes he became more restless, called more frequently, and soon ran some distance to windward of the nest and took wing. Within a few minutes the female alighted on the sand near the nest and went abruptly to it and settled upon the eggs. This maneuver was repeated many times, with slight modifications. Upon the slightest disturbance the birds leave the nest and circle about overhead, calling excitedly and loudly, often making sallies at the head of the intruder. At first it seemed impossible to select the parents from the other scolding birds which constantly hovered over me, and since one can seldom find a nest which is sufficiently isolated to enable one to concentrate attention upon it alone, there might well be confusion as to the owners of any given nest. But with the young the case is more definite. When a young bird is picked up, two of the hovering birds become much bolder than the rest, dashing within a few feet of the intruder. After considerable careful study it became

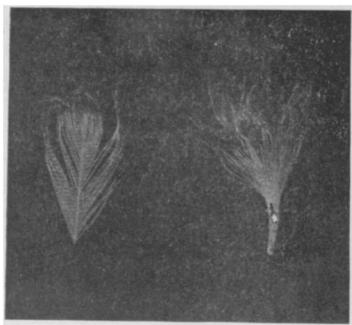
evident that while there is always a community of interest in the whole colony the aggressive protest against the intruder is confined to the birds immediately interested. In cases of doubt as to whether the nest under observation was that of *hirundo* or *dougalii* it was only necessary to remain quietly near the nest until all but one or two of the birds tired of the demonstration of hostility. The female was invariably the more aggressive.

Not much of the incubation of the eggs is left to the heat of sun and sand, but the birds brood almost constantly. Eggs left exposed to the sun for any considerable time die. A large number of eggs do not hatch. Some are evidently infertile, but many die from lack of proper care. Incubation evidently begins when the first egg is laid.

The first feather rudiments appear as little swellings upon the skin surface on the fifth day of incubation. By the tenth day they have greatly elongated and turned backward to lie parallel to the skin surface, many of them being pigmented. These rudiments of the first or nestling downs appear first on the tail, then successively forward to the forehead along the feather tracts, except that in the region of the large wing feathers they begin to appear at about the time when those on the lower back are first seen. On the 18th day of incubation the down feathers in the region of the outer primaries begin to show enlarged bases beneath the skin. These enlargements are the beginning of the future juvenile flight feathers. When the bird hatches its down feathers are unexpanded and look like wet hairs plastered against the skin. They remain in this condition during the first day after hatching, but on the second day the enclosing sheath dries and splits and the liberated and dried down barbs expand and cover the skin surface with a soft, fluffy plumage. On the third day after hatching the flight feathers appear at the surface of the skin and in their further growth push the down feathers out of their pockets. At first the new feather is enclosed by a horny sheath which keeps it in the "pin feather" form, with the tuft of down sticking to its pointed tip. In three or four days the horny sheath dries and splits away from the tip and the new feather flattens out into

a perfect feather. The down is seen to form a fringe along the tip of the flattened feather (Fig. 3), each down barb being attached to one or more of the barbs of the new feather. This down fringe wears off rapidly on all exposed parts, but is sometimes found in protected places on young birds some days after they begin to fly about. The young bird can fly feebly by the eighth day after hatching.

Figure 3.



Juvenile definitive feathers of *S. hirundo* with down barbs attached to their tips.

The embryo, on the 18th day of incubation, lies doubled up in the egg, with the head turned under the body resting on the abdomen, just in front of the elongated yolk sac. The bill is thrust between the right knee and elbow, inclining slightly toward the body, the left foot touching the neck, just back of the ear, the right foot resting on the forehead, almost touching the right eye.

By the 18th day of incubation the shell is cracked in one or more places near the large end. The cracks are radially arranged in areas, and are clearly produced by pressure upon the shell from within. Examination reveals the fact that beneath each cracked area lies some protruding part of the embryo—the knee, bill, or shoulder—which is in contact with the shell when the embryo has a muscular contortion. A faint peeping can be heard at this time.

On the 19th, in a few instances on the 20th day of incubation, the shell was found broken through by the tip of the bill for a space the diameter of the tip of the bill. This break was usually near the center of the first seen cracked area. I did not find any instance in which this air hole was materially enlarged, nor any instance in which any other holes were made in the shell. On the 21st day of incubation the muscular contortions of the chick resulted in bursting off the entire large

end of the egg. The chick then readily wriggled himself free from the remainder of the shell. The yolk sac is drawn into the body and closed at the end of the 20th day of incubation.

During the first day after hatching the young bird lies in an apparently exhausted condition, and receives no food. Feeding begins on the second day. Late hatched young are likely to be attacked by myriads of the little red ants which infest the islands, and many are killed by them.

Regurgitation is never practiced by this tern. The fish, here usually the sand lance (*Ammodytes americanus*), is caught in the water and is held by its middle while it is being carried to the waiting young. The fish is deftly turned head toward the chick and thrust into its mouth or even pushed down its throat. The size of the fish did not necessarily bear any relation to the size of the chick. It was no uncommon thing to find a two-day-old chick peacefully sleeping in the nest with an inch or more of fish protruding from its mouth. It was forced to eat its fish by intallments! Several fishes forcibly removed from protesting young had the head and upper part of the body digested, while the tail region was still exposed to the air.

The young usually remained in the nest for the first three days, but on the fourth day they left it but remained near. Young hatched in nests placed among thick grass, as on Penikese island, remain in the vicinity of the nest until they can fly away from it. Here there are paths trodden in the grass, radiating from the nest in several directions, but seldom farther than a rod from the nest. The young are fed by the parents or parent until some time after the young are able to fly about and accompany the old to the fishing grounds. I have never seen a young bird fed while both birds were flying. Invariably the young, at least, settles upon the water before receiving the fish, and shakes his plumage as from defilement after receiving it.

I have never seen either the young or old birds eat the remains of the egg shells, nor have I ever found remnants of the shells in the digestive tracts of the birds, but I have found shells from which young had unmistakably escaped in the water where they could not possibly have been blown by the wind.

Shells are not left in the nest, and there is some evidence for believing that the old birds remove them and carry them some distance before dropping them.

How do the old birds recognize their own young among the multitude of young birds congregated on the beach? was a question which occupied a good deal of my attention and interest. After the young leave the nest and its vicinity they wander about aimlessly and may be at widely different places at two visits of the old birds. Hence it often becomes a serious question on the part of the parent how to find its offspring. Abundant opportunity was afforded for studying this question. Old birds with young which had left the nest, when coming in with a fish, stooped to examine each group of young in turn until a young bird, apparently its own, was found, when the old bird alighted. Immediately the youngster began to dance and call vociferously, but not until the old one had touched the young one with its forehead was the question decided. Often this minute inspection was immediately followed by the departure of the old bird without delivering the fish, the quest for its own young being renewed. It thus became clear that sight alone was not depended upon for recognition, but that the final decision rested upon the sense of smell. Sometimes the quest resulted in failure, when the old bird swallowed the fish. The evidence seemed to indicate that these terns feed only their own young.

THE ROSEATE TERN. (*Sterna dougalli*)

I found the Roseate Tern breeding only on the Woepecket, Penikese, and Muskeget islands. Everywhere their numbers were far less than those of the Common Tern. On the Woepeckets they were largely confined to the two smaller islands, on Penikese to the north-eastern border and on the sand shoal locally known as Little Penikese, and on Muskeget to the narrow neck extending toward the long sand pit of Tuckernuck.

This tern seems to be far more fastidious about its nesting than the Common Tern. I found no nests that were not in the midst of grass, and the nest is generally well hidden by a covering of grass. In such situations the nests are more diffi-

cult to find, and the finer spotting of the eggs renders them less conspicuous in the shade of the grasses.

Only two nests were studied to the completion of the incubation period, but these had an incubation period of 21 days. In general the habits do not differ from those of the Common Tern. Their instincts inclined them to be more wary, but they were more courageous when their nests or young seemed in danger. An outraged pair would even follow the intruder from one of the Woepacket islands to the other, fighting all the way.

THE PLUMAGE OF *S. HIRUNDO* AND *DOUGALLI*.

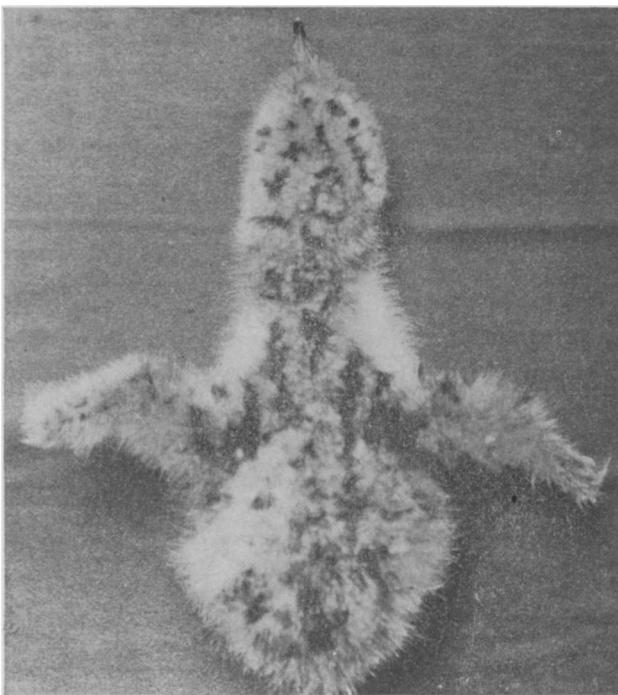
Any such study would lack completeness that did not mention the plumages of the downy young and the young birds in their first definitive feathers.

The downy young of *hirundo* is mottled with tawny and black or dusky, the mottling varying within small limits with the individual. The whole throat is dusky, but the rest of the under-parts are pure white. The expanded, fluffy down feathers form a complete covering for the body, but they grow only in the feather tracts which are characteristic of the terns. Figure 4 illustrates the pattern of mottling. This pattern seems particularly well adapted for the concealment of the chick among the rubble of the beach or upon the drift seaweed. On the gray sand or among the yellowish grass, however, the young is readily detected because its colors are here contrasty. While the young remain in the nest they seldom show fear, but raise their heads and open their mouths for food.

The downy young of *dougalli* are tawny *streaked* with dusky. One could not confuse this pattern with that of the downy young of *hirundo*. The legs of the young *hirundo* are coral red or lighter, while the legs of the downy young *dougalli* are invariably almost black. The streaked pattern of the *dougalli* chick renders the bird almost invisible in the grass covered nest. The young of *dougalli* flatten themselves down into the nest in apparent fear upon the approach of an intruder. When they leave the nest they hide away under the grass. Their difference in color pattern seems to go with a difference in disposition.

The young in his first definitive feather plumage is, in *hirundo*, barred across the back and wings with dusky brown and rufous. The main body of the feather is "gull blue," its distal end is rufous-brown for the space of several millimeters in width, and between this rufous brown distal margin and the field of "gull blue" there is a crescent of black which is very

Figure 4



Common Tern (*Sterna hirundo*). Downy young, three days old.

variable in extent. Enough of the feather is exposed to show the three colors mentioned above. The combined effect is a distinct barring of the color pattern of the upper parts. The entire under parts are pure white. In *dougalli* the pattern is more varied and is well illustrated by figure 1. Here the black tends to form more than one bar.

The habits of the partly fledged young, before they are capable of flight, lend color to the supposition that these color patterns are protective in nature.

I could discover no evidence, however, to prove that the young birds are conscious of the protective nature of their color patterns. The downy young usually squatted and "froze" when the parent uttered the alarm cry, and the partly fledged young usually ran to hide—invariably trying to crawl under something.

The streakiness of the *dougalli* downy young harmonizes with the shadows which the grass overhanging the nest cast. After they leave the nest they are difficult to see beneath it, because the colors and pattern of the downy plumage harmonize well with the grass and shadows. The blotchiness of the *hirundo* downy young harmonizes with the rubble of the beach and, while there is more contrast with the grass in which some are found than with the downy young of *dougalli*, there is yet harmony enough to make the young bird inconspicuous while it is still.

The juvenile *hirundo* hides, or tries to hide, like the Ostrich—by thrusting its head beneath the grass cover. Its head is nearly black with a light colored frontlet, while the barring of the rest of the upper parts with tawny and dusky or black harmonize with the grass beneath which the head is thrust. Persons who had not studied the terns in their nesting places were unable to see the young when so placed. Under broad leaved plants these young were readily seen after the leaves had been parted. The juvenile *dougalli* pushes himself completely beneath the grass or leafy retreat. When the covering is partly removed his peculiar pattern of barring and mottling makes him inconspicuous. His habit of moving toward deeper cover when his hiding place is disturbed betrays him.

The pure black crown, pure white under parts, and clear "gull blue" upper parts of both of these terns in adult plumage is well known. If there be any protective coloration in the adult pattern it must be while the birds are a-wing, for they are conspicuous objects when a-light.

The color pattern of the downy young is outlined when the down feathers first make their appearance upon the skin surface of the six-day embryo. That is, the pigment begins to develop in the down feathers which are to be black almost as soon as the feather papilla appears upon the skin surface. An entire down feather is seldom all one color, but those which are black at the tip are tawny in the middle and black at the base, and those which are tawny at the tip are also black at the base. This applies only to the down feathers of the dorsal surface. There are many down feathers on the ventral surface which are wholly white.

Taking the three plumages as illustrating a process of evolution of color pattern, and taking the streakiness of the downy young of *dougalii* as the more primitive, we may readily perceive that longitudinal stripes of color break up into transverse bars, and the bars give place to a uniform distribution of color. In the evolution of the present adult coloration of the terns of the genus *Sterna*, it seems probable that a primitive longitudinal streaking became broken up into longitudinal series of spots which were arranged in transverse series so as to give the appearance of broken bars; these series of spots extended laterally, fused, and so became in reality transverse bars, which, spreading and finally fusing, resulted in the uniform coloration of the dorsal region in *Sterna* adults. Such a transition would be in complete conformity to the law announced by Eimer ('82).

A PRELIMINARY LIST OF THE BIRDS OF SENECA
COUNTY, OHIO.

BY W. F. HENNINGER.

The need of a new county list of birds in Ohio may be questioned, with two excellent state lists—Jones' and Dawson's—of recent issue; but it is only after every county in the state has been worked over with care that we shall feel warranted in saying that any list is more than preliminary in character. And if this county list, though by no means exhaustive